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(71)	Name and residence of owner	Mecron Mediziniesche Produkte GmbH, 1000 Berlin, DE
(74)	Name and residence of agent	Christiansen, H., B.S.-Eng., Patent Attorney, 1000 Berlin

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MECRON
Medizinische Produkte GmbH
D-1000 Berlin
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Endoprosthesis of the Intervertebral Disk

D e s c r i p t i o n

The invention relates to an endoprosthesis of the generic part listed in claim 1.

Such an intervertebral disk prosthesis is known from DE-A1-35 29 761 (Figures 11 to 14), in which a cylinder-shaped intermediate element with concave formed end faces is bedded between correspondingly formed convex surfaces of two neighboring

vertebral bodies, and non-incorporated cover plates. This intervertebral disk replacement allows a mutual rotation of the vertebras around a center axle. Any further movement possibilities are limited as the intermediate element itself is limited in every other movement, i.e. with parallel shifting or tilting of the vertebral bodies by the flange-like top surface, or the vertebral bodies, respectively.

An additional disadvantage is that the distance between both vertebral bodies is also rigidly fixed, and insofar conditions exist that substantially deviate from the naturally physiological conditions.

The force transmission into the vertebral bodies is therefore very uneven so that the storage surfaces between the intermediate element and the cover plates are exposed to high locally mechanical stress. This can result in the material particles peeling away, which may be dangerous for the patient on one hand, and a reduced service life of the endoprosthesis on the other hand. Bone destruction is promoted by possible local unilateral stress.

In another vertebral body described in the above mentioned specification (Figures 1 to 3) the intermediate element is designed in a convex form, while the exterior cover plates possess concave counter surfaces.

Here, a yielding of the top surfaces in the direction of the axle is also not possible. Further, no movement in the direction of the parallel shift of the top surfaces is possible.

Additionally, an endoprosthesis of the intervertebral disk is known from the German utility model G 88 07 485.4 that is filled with elastic material and equipped with frontal cover plates, whereby a circular, or elliptical corrugated pipe surrounding the viscoelastic material is intended that is closed by cover plates.

The disadvantage of this prosthesis is that the entire balancing motion must be absorbed exclusively by the corrugated pipe.

The invention is based on the task of stating an endoprosthesis of the above referenced class with improved mobility and increased loading capacity, whereby it is simultaneously avoided that material particles peel away during frequently changing stresses.

This task is solved with the characteristic features of claim 1.

A particular advantage of this type of endoprosthesis is the large motion range of the viscoelastic intermediate elements with both ball joints, and the resulting flexibility required for bending, torsion, shearing and pressure stresses. This helps to avoid stresses with opposite radial forces affecting the neighboring vertebral bodies, which can lead to the breakage of the elastic intermediate elements of the endoprosthesis. It also safely avoids the peeling away of material particles due to surfaces rubbing against each other, which would lead to a vagabonding in the patient's body.

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The invention is based on the recognition that a maximum motion is achieved only by the combination of an elastic intermediate element with a jointed bearing of its concave-shaped ends interacting with the correspondingly convex counterparts at the end plates; the maximum motion allowing a minimum of wear, and a maximum of durability in all stresses occurring. For instance, this type of bearing (as opposed to a bearing with convex ends of the intermediate element) also allows a shifting of both cover plates relative to each other on a parallel path. Compressive forces are absorbed by the elastic intermediate element.

The jacket area of the intermediate element is exposed to a special stress that is absorbed by the deformation. The pliable jacket area of the intermediate element in the inventive endoprosthesis is not lessened by components of both frontal ball joints so that sufficient room is available for the sheathing of the intermediate element. The sheathing of the interior consisting of viscoelastic plastic is designed as a corrugated pipe. Because the corrugated pipe is able to take up its entire height, it possesses a large elasticity range, and is therefore able to follow all conceivable movements.

Due to the oblique position of the elastic intermediate element, the lateral motion of the cover plates connected to the bone relative to each other is enabled most beneficially. The gliding planes of the ball cup-type forms of the intermediate element ends are

preferably coated with a friction reducing plastic coating, in particular made of (highly molecular) polyethylene.

According to a beneficial further development of the invention, the cover plates are designed like a pot, whereby the opening areas are facing each other. This creates limit stops, or compression, respectively, against the lateral movements of the elastic intermediate element with lateral shifting, or compression, respectively, so that overstressing of the intermediate element, and in particular of the corrugated pipe surrounding a viscoelastic filling, is safely avoided.

Both pot-like cover plates of the vertebral body are initially tautened against each other by means of wires welded to the cover plates which results in the stabilization of the configuration for transport and storage on one hand, and which eases the implantation procedure on the other hand. The tautened wires can easily be cut and removed after the implantation procedure.

In another beneficial further development, the ball cap-like form consists of a complete ball that is bedded in an additional convex form of the cover plate.

Beneficial further developments of the invention are identified in the sub-claims, or are illustrated in further detail together with the description of the preferred design of the invention in the following figure.

The figure illustrates a sectional view of a design of the inventive endoprosthesis with a lateral shifting of the cover plate indicated by a semicolon line.

The endoprosthesis of the intervertebral disk illustrated in the figure essentially consists of two cover plates 1 and 2 connected to neighboring vertebral bones, an elastic intermediate element 3, and two ball joint-type bearings 4 and 5 arranged between the cover plates 1, 2, and the intermediate element 3. The bearings 4 and 5 each possess an element (convexly) formed as a ball cap 6 or 7 that is connected to the cover plate 1, or 2, as well as an element (concavely) formed as a ball cup 8 or 9 that is connected to the intermediate element 3. Both ball cup and ball cap each can be pivoted against each other, as well as tilted toward each other. The joint connection enable a tilting of the cover plates relative to each other—according to a bending movement—as well as a parallel gliding movement of the cover plates with an oblique position of the intermediate element.

The intermediate element 3 is designed as a metal corrugated pipe 10 surrounding a filling consisting of a viscoelastic material. The jacket consists of corrugated metal sheeting. The body compatible metal of the endoprosthesis uniformly consists of either titan or stainless steel.

It is apparent that the abaxial jacket area 11 of the intermediate element is not shortened or lessened by both frontal ball cups 8 and 9. A maximum length is available to the jacket 10. The motion of the components 1 and 3, 3 as well as 4 and 5 of the endoprosthesis

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therefore largely corresponds to the motion of a natural intervertebral disk. Even extreme movements of the vertebral bones, and therefore of the cover plates 1 and 2 against each other are possible without the risk of breakage, and without any particle abrasion. The contour 1' indicated by a line of semicolons illustrates such a movement corresponding to a lateral parallel shifting. The cover plate 1 is laterally shifted up to the position 1', whereby an approximate height shifting can be compensated by the viscoelastically filled intermediate element 3. In order to be able to follow this movement, the ball cup 8 connected to the intermediate element 3 glides in the opposite direction on the ball cap 6. At the same time, a gliding of the ball cup 9 occurs in shifting direction of the cover plate 1 on the ball cap 7 of the cover plate 2. By means of this gliding motion in opposite directions, the intermediate element 3 assumes an oblique position 3' to the starting position indicated by an inclined straight line 3' in vertical direction.

The gliding surfaces 12 and 13 of the ball cups 8 and 9 are coated with a thin gliding coat consisting of highly molecular polyethylene for the purpose of reducing friction, which is mechanically fixed toward a slotted surface.

Both cover plates 1 and 2 possess pot-like exterior contours, whereby the opening areas are facing each other and are equipped with ring-shaped formed edges 14 and 15. Due to the pot shape of the cover plates 1 and 2, an excessive compression of the intermediate

element 3 is avoided during extreme compression forces. The maximum compression is achieved when the edges of the pot-shaped cover plates 1 and 2 touch each other. The opening width is selected so that a lateral guide stop is formed for the corrugated pipe 10 of the intermediate element 3 in lateral movements (semicolon lines) so that the lateral deflection is also limited, and an additional stabilization is ensured.

The formed edges 14 and 15 simultaneously serve for attaching the tension wires 16 and 17 indicated by the dashed lines, which prevent the disk elements from falling apart during the transport, ensure precise positioning during implantation, and are removed after the implantation procedure by means of cutting.

All elements of the illustrated intervertebral disk, with the exception of the viscoelastic filling of the intermediate element 3, consist of body compatible metal alloys. The exterior top surfaces 18 or 19 of the cover plates 2 or 3 are equipped with a porous surface, or a surface coating so that neighboring spongy bone tissue is enabled to grow. For this purpose, the bordering vertebras are milled in such a way that the spongiosa is exposed and adjusted to the corresponding cover plate.

The inventive solution also ensures that both a lateral shifting and a twisting of the cover plates against each other with regard to all ambient axles can take place at low friction.

Furthermore, pliability with compression is possible. Additionally, the motions are limited by means of fixed limit stops in such a way that additional stresses are prevented. Also, a space that can be taken in by the intermediate element, and preferably by the edge areas of the intermediate element is available to the jacket designed as a corrugated pipe outside of the area of the convex designs of the cover plates, and within the pot-like formed edges so that its elasticity characteristics can be optimized essentially without any dimensional limitations. For this purpose, a ring-shaped free space (20, 21) is intended between the ball cap-shaped design 6, 7 and the interior edge of the formed edges 14, 15, into which the edge 22 of the intermediate element 3 can extend during its relative movement, as shown in the drawing.

In another design – not illustrated in the drawing – the ball cap-shaped form consists of a complete ball that is bedded in a further convex form of the cover plate. This ensures a simplified ability to manufacture using usually available construction elements at usually corresponding advantages. The convex forms are each adjusted to the ball diameter.

The metal components of the inventive prosthesis in their preferred designs are each manufactured either of titan or steel in the form of body compatible alloys.

The design of the invention is not limited to the example named above. Instead, a number of variations is conceivable, which make use of the solution illustrated, even in generally different types of designs.

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Claims

1. Endoprosthesis of the intervertebral disk with an intermediate element, the end faces of which are pivotable by means of a spherically-concave, and therefore ball cup-like form each between two corresponding spherically-convex, and therefore ball cap-like forms at the interior surfaces of two cover plates,

characterized in that

the intermediate element (3) is designed as an elastic element with viscoelastic characteristics.

2. Endoprosthesis according to claim 1, characterized in that the ball cap-like form (6, 7) is designed to be higher than the ball cap-like form (8, 9).

3. Endoprosthesis according to one of the previous claims, characterized in that the gliding surfaces (12 and 13) of the ball cup-like forms (8 and 9) and/or the ball cap-like forms (6 and 7) possess a friction reducing plastic coating.

4. Endoprosthesis according to claim 3, characterized in that the friction reducing plastic coating consists of highly molecular polyethylene.

5. Endoprosthesis according to one of the previous claims, characterized in that the cover plates (1 and 2) are designed in a pot shape by means of formed edges (14, 15), whereby the formed edges are facing each other.

6. Endoprosthesis according to claim 5, characterized in that the formed edges (14 and 15) are tautened in a mutually fixed position by means of welded wires (16, 17).

7. Endoprosthesis according to one of the previous claims, characterized in that the intermediate element (3) is filled with viscoelastic material that is surrounded by an elastic corrugated pipe (10) between the end faces.

8. Endoprosthesis according to one of the previous claims, characterized in that a ring-shaped free space (20, 21) is intended between the ball cap-like form (6, 7) and the interior edge of the formed edge (14, 15) into which the edge (22) of the intermediate element (3) can extend during its relative movement.

9. Endoprosthesis according to one of the previous claims, characterized in that the

ball cap-like form consists of a complete ball that is bedded in a further convex form of the cover plate.

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